Space Technology Research Grants

Modeling of the Nanometric Regime of Cone-Jets to Improve the Design and Understanding of Electrospray Thrusters

Completed Technology Project (2017 - 2020)

Project Introduction

This project will reproduce the electrohydrodynamic phenomena taking place in electrospray thrusters by constructing and numerically solving a model of cone-jets with realistic boundary conditions. The ultimate goal is to produce a modeling tool for guiding the design and optimizing the operation of electrospray thrusters. The key innovation is the inclusion, for the first time, of physics key to the operation of electrospray thrusters, namely ion evaporation and energy dissipation. Model results will be validated with experimental measurements of relevant electrospray characteristics. The interest in smallsats has exploded in the last two decades due to advancements in electronics, power and fabrication techniques, combined with the significant lower mission costs associated with the fabrication and launch of these platforms as secondary payloads. However, the current absence of advanced micropropulsion is preventing the use of smallsats in missions of high value to NASA such as spacecraft constellations, formation flying, insertion into high altitude orbits, interplanetary voyage, etc. The minimum thrust and power at which electrospray propulsion can operate, its high efficiency, the small footprint per emitter, and the easiness for scale up, make electrospray propulsion a technology ideal for primary propulsion and attitude control of cubesats and larger smallsats. This project will produce the fundamental knowledge needed to fulfill its potential.

Anticipated Benefits

A successful project will provide the model needed to design and optimize electrospray thrusters. Electrospray propulsion is an enabling technology for smallsats, one that will make it possible to use them in high value missions such as spacecraft constellations, formation flying, insertion in high altitude orbits, interplanetary voyage, etc. The fundamental knowledge provided by the model is needed to fulfill the potential of electrospray thrusters The model will also be useful for other electrospray applications based on the nanometric regime. The obvious applications is the use of nanodroplet beams for surface engineering (e.g. high rate sputtering, surface amorphization and texturing, etc.), which also requires the acceleration of nanodroplets to hypervelocities

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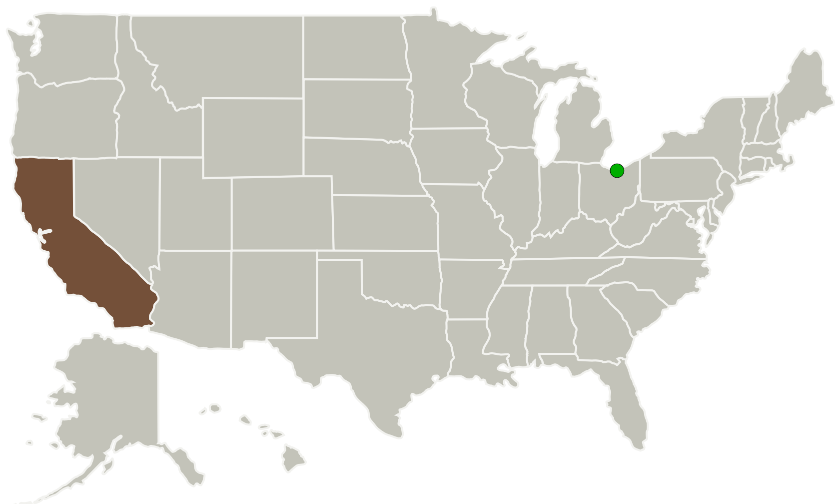
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of California-Irvine	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI), Hispanic Serving Institutions (HSI)	Irvine, California
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations
California

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of California-Irvine

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

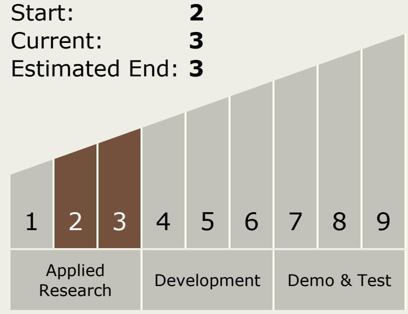
Hung D Nguyen

Principal Investigator:

Manuel Gamero-castano

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX01 Propulsion Systems
  └ TX01.2 Electric Space Propulsion
    └ TX01.2.2 Electrostatic

Target Destinations

The Sun, Outside the Solar System